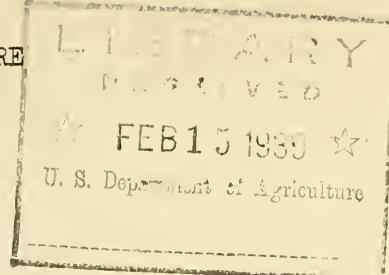


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INVESTIGATION ON PEACHES
1938

Report on the relation of maturity and temperatures in transit to length of marketing period, quality, and conditions, and on the advantages of ventilated cover pads.

By

E. D. Mallison, associate horticulturist;
C. O. Bratley, associate pathologist; and
J. S. Wiant, associate pathologist; Division
of Fruit and Vegetable Crops and Diseases.

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REPORT ON SHIPPING TESTS WITH PEACHES
Georgia to New York City
June and July, 1938.

The experimental work with peaches during the 1935 season showed that the tight, nonventilated basket in common use at that time prevented rapid cooling during the precooling period when the fruit was loaded into refrigerator cars. Experiments were conducted during the 1936 and 1937 seasons to develop a ventilated package and determine the rate of cooling of fruit packed in various containers, and the effect of various temperatures on the keeping quality and dessert quality of peaches. It was apparent from these studies that precooling was of little, if any, value for peaches that were immature or hard at time of shipment.

The object of the tests during the 1938 season was to determine (1) whether firm peaches could be shipped under commercial practices from Georgia, (2) the influence of transit temperature on the dessert quality of firm peaches as compared with hard peaches and on the length of their marketing period, and (3) whether the use of the ring-ventilated pad (previously developed) with nonprecooled shipments increased the length of the period during which the fruit could be marketed. The successful shipment of firm peaches would give consumers fruit of better dessert quality than they are now generally obtaining from Georgia, and this should increase demand and consumption.

Maturity Standards

The various classifications of maturity as defined by the Inspection Service of the Bureau of Agricultural Economics were used in these experiments. These standard terms are defined as follows:

"Hard should be used to describe peaches that are still green color but mature enough to indicate they will ripen rather than shrivel. They are too green to appear attractive to the retailer who wishes to sell them at once, but are satisfactory for storage or shipment.

"Firm should be used to describe peaches that have not reached the stage of maturity at which they are of the best eating quality. The ground color is usually creamy white or yellow and barring fungus rots will keep in good condition for several days.

"Ripe or soft peaches are those that need to be consumed immediately. They will break down within a couple of days andcannot be shipped to market and arrive in suitable condition to be handled in regular trade channels without waste."

Methods

Three carlot shipments of Hilco, one of Georgia Belle, and three of Elberta peaches were used in these tests.

At time of packing, the test lots of peaches were taken from the bin of the grader. Those having grayish-white to creamy-white or yellowish ground color, even though a few were slightly soft at the suture, were classified as firm; those showing green color were classified as hard and were placed in a second lot. The shoulders of the fruits in this second lot were generally rounded out and the flesh separated from the pits. 1/

1/ When the "shoulders" are not well rounded out and the flesh adheres to the pit, the fruit is generally considered immature.

There was a marked difference in the color and appearance of the two lots used in each of the tests. Growers estimated that the firm fruit was from 1-1/2 to 2 days more advanced in maturity than that classified as hard.

Representative samples of 25 to 40 fruits were taken from each of these two lots, and data were obtained on hardness of flesh and the ground color of the least mature portion of each fruit. The U. S. D. A. pressure tester, with 5/16-inch plunger, was used to determine the hardness of the flesh, while the color readings were made with a color chart based on standards found in the Dictionary of Color by Maerz and Paul.

The test fruit was packed in the usual manner and loaded in commercial shipments to New York and Philadelphia. Two comparable lots were placed in each load, one in the bottom layer of the stack next to a bunker bulkhead (the coolest part of the load), while the other was placed in the top layer of a stack between the doors (the warmest part of the load). The three test baskets in each lot were packed as follows:

- (1) Hard fruit, ventilated pad.
- (2) Firm " " "
- (3) Firm " , standard "

Each carlot test shipment made possible the following comparisons:

- (1) influence of low and high transit temperatures on firm and hard fruit,
- (2) length of marketing period of hard and firm fruit exposed to high and low transit temperatures, when held subsequently at room temperatures (corresponding to store temperatures),
- (3) dessert quality of hard and firm peaches after ripening, and
- (4) effect of ventilated cushions on the condition of hard and firm peaches when carried in non precooled shipments.

A thermograph was placed at the center of two or three of the test baskets loaded at the top doorway and bottom bunker positions. The test cars were shipped under standard refrigeration plus 3 percent salt.

Inspection at Destination: The six test baskets in each car were removed at destination at time of unloading and were thereafter kept at a room temperature, which ranged from 70 to 85 F, averaging 74° to 82.5°. Samples from each basket were removed periodically and tested for quality and condition. Data were obtained on the firmness of the flesh and on color, using the same methods as at shipping point. These inspections were made shortly after unloading and daily thereafter until the fruit was soft ripe, or ready for consumption.

Results

Softening of Fruit in Transit:

The amount of ripening or softening of peaches while in transit varies with its temperature: the higher the temperature the faster is the rate of ripening. Table 1 shows that fruit classified as firm at time of shipment arrived with 55.7 percent firm and 36.4 percent ripe when shipped at the top doorway position (the warmest part of the load); comparable fruit from the bottom bunker position (the coldest part of the load) arrived with 94.3 percent firm to hard and only 5.7 percent ripe. Likewise, peaches that were classified as hard at shipping point arrived with 29 percent of the fruit still hard at the top doorway position, as compared with 46 percent hard at the bottom bunker position and none ripe at either position.

Table 2 shows that precooling retarded the rate of ripening during the transit period. The influence of precooling was most noticeable in the firm fruit at the top doorway position, where the amount of softening

T A B L E 1

SOFTENING OF PEACHES WHILE IN TRANSIT FROM GEORGIA TO NEW YORK CITY, JUNE and JULY, 1938.

| Test No. | Variety | Date Loaded | Fruit in Refrigerator Car | Maturity when Loaded | Average Pressure Test | | Maturity at Time of Unloading | | | |
|----------|-----------|-------------|---------------------------|----------------------|-----------------------|----------------|-------------------------------|------|------|------|
| | | | | | When Loaded | When un-loaded | Soft | Ripe | Firm | Hard |
| | Top Layer | | Days | | lbs. | lbs. | % | % | % | % |
| 1 | Hiley | 6-14 | 2.5 | Firm | 13.8 | 3.2 | 2.5 | 50.0 | 47.5 | - |
| | " | 6-15 | 2.5 | Hard | 16.2 | 6.5 | - | 25.0 | 72.5 | 2.5 |
| 2 | " | 6-17 | 2.5 | Firm | 13.8 | 4.8 | - | 30.0 | 70.0 | - |
| 3 | " | 6-17 | 2.5 | Hard | 17.3 | 10.0 | - | 7.5 | 80.0 | 12.5 |
| 4 | Ga. Belle | 6-27 | 2.7 | Firm | 14.4 | 5.0 | - | 45.0 | 55.0 | - |
| | " 1/ | | | Hard | 18.2 | 11.0 | - | 2.5 | 85.0 | 12.5 |
| 5 | Elberta | 6-28 | 4 2/ | Firm | 16.5 | 11.8 | - | - | 52.5 | 47.5 |
| | " | 6-29 | 2.5 | Hard | 19.8 | 14.9 | - | - | 10.0 | 90.0 |
| 6 | " | 7-1 | 5.3 | Firm | 17.0 | 5.6 | - | 50.0 | 50.0 | - |
| | " | | | Hard | 20.2 | 12.5 | - | 2.5 | 65.0 | 32.5 |
| 7 | " | 7-1 | 5.3 | Firm | 17.2 | 7.8 | - | 15.0 | 80.0 | 5.0 |
| | " | | | Hard | 19.2 | 13.8 | - | - | 67.5 | 32.5 |
| Average | | | | Firm | 16.1 | 6.8 | - | 65.0 | 35.0 | - |
| | | | | Hard | 18.2 | 13.6 | - | 7.5 | 72.5 | 20.0 |
| | Average | | | Firm | - | - | 0.4 | 36.4 | 55.7 | 7.5 |
| | | | | Hard | - | - | 0.0 | 6.4 | 64.7 | 28.9 |

| Bottom Layer | | | | | | | | | | |
|--------------|-----------|------|------|------|------|------|-----|------|-------|------|
| | | | | | | | | | | |
| 1 | Hiley | 6-14 | 2.5 | Firm | 13.8 | 11.8 | - | 2.5 | 87.5 | 10.0 |
| 2 | " | 6-15 | 2.5 | Hard | 16.2 | 12.3 | - | 7.5 | 50.0 | 42.5 |
| 3 | " | 6-17 | 2.5 | Firm | 13.8 | 11.8 | - | 15.0 | 85.0 | - |
| 4 | " 1/ | 6-27 | 2.7 | Hard | 17.3 | 12.6 | - | 2.5 | 77.5 | 20.0 |
| 5 | Ga. Belle | 6-28 | 7 2/ | Firm | 14.4 | 8.9 | - | - | 100.0 | - |
| | " | 6-29 | 2.5 | Hard | 18.2 | 12.9 | - | - | 77.5 | 22.5 |
| 6 | Elberta | 7-1 | 5.3 | Firm | 16.5 | 13.8 | - | - | 37.5 | 62.5 |
| | " | | | Hard | 19.8 | 14.5 | - | - | 10.0 | 90.0 |
| 7 | " | 7-1 | 5.3 | Firm | 17.0 | 10.1 | - | 7.5 | 72.5 | 20.0 |
| | " | | | Hard | 20.2 | 14.8 | - | 7.5 | 37.5 | 55.0 |
| Average | | | | Firm | 17.2 | 10.6 | - | 5.0 | 72.5 | 22.5 |
| | | | | Hard | 19.2 | 13.9 | - | 2.5 | 27.5 | 70.0 |
| | | | | Firm | 16.1 | 8.4 | - | 10.0 | 90.0 | - |
| | | | | Hard | 18.2 | 14.7 | - | - | 77.5 | 22.5 |
| | Average | | | Firm | - | - | 0.0 | 5.7 | 77.9 | 16.4 |
| | | | | Hard | - | - | 0.0 | 2.8 | 51.1 | 46.1 |

1/ Car in test 4 precooled; all others not precooled.

2/ Top layer test baskets in car 4 days; bottom layer baskets, 7 days.

in nonprecooled peaches was about twice that in precooled fruit. Since the

T A B L E 2

AVERAGE CHANGE IN PRESSURE TEST (IN POUNDS) OR SOFTENING
OF PRECOOLED AND NONPRECOOLED FRUIT WHILE IN TRANSIT FROM
GEORGIA TO NEW YORK CITY AS DETERMINED BY THE U. S. D. A. PRESSURE TESTER

| | Hard 1/ | | Firm 1/ | |
|-------------------|-------------|--------------|-------------|--------------|
| | Top Layer | Bottom Layer | Top Layer | Bottom Layer |
| | <u>lbs.</u> | <u>lbs.</u> | <u>lbs.</u> | <u>lbs.</u> |
| Precooled..... | 5.0 | 5.3 | 4.7 | 2.7 |
| Nonprecooled..... | 7.0 | 4.7 | 9.8 | 5.1 |

1/ Maturity of test fruit at time of loading

fruit at the bottom bunker position was cooled rapidly in both the precooled and the nonprecooled loads there was not a great deal of difference in the amount of softening of the test fruit at this position in any of the cars.

Rate of Softening After Arrival

The temperature of the room in which the fruit was held varied with the different tests. The lowest temperature was in the first test when the temperature ranged from 70° to 78°, with an average of 74° F., and the highest was in tests 5 and 7, where the temperature ranged from 80° to 85°, averaging 82° F. The average temperature during the other tests ranged from 76° to 78°. These temperatures corresponded rather closely with temperatures in the stores where the peaches would have been held for sale had they gone into commercial trade channels.

As peaches approach the ripe stage the flesh becomes increasingly soft and eventually offers little or no resistance to the plunger of the pressure tester, hence the data obtained with the instrument at the ripe stage have little value. Within a short time after unloading each basket was found to contain peaches of several stages of ripeness. Under these conditions, the writers believed that showing the number of days at which each basket was held at room temperature before reaching best conditions "for the retailer", and "for the consumer" would give the most useful information. In this connection it was assumed that the retailer would desire peaches in a firm-ripe to firm condition, with very few ripe, and that the consumer would generally want ripe peaches.

The data shown in table 3 indicate that the nonprecooled firm peaches shipped in the top layer were generally suitable for the retailer upon unloading, with some a little riper than would be desired. The precooled firm fruit from this position, however, compared favorably with similar fruit shipped at the bottom bunker position. It required about 1 day's holding of the hard fruit from the top layer before it reached the best condition for the retailer.

The firm fruit shipped in the bottom layer (table 3) required from 1 to 2 days before becoming "firm-ripe to ripe, few ripe". The hard fruit required about 1 day longer.

Table 4 shows that the peaches could be held from 1 to 2 or 3 days before becoming generally ripe and were still suitable for consumption 1 to 2 days after that. The difference in time required was due to the difference in maturity at time of shipment and to differences in transit temperature. Firm peaches from the top layer required from 1 to 2 days to become ripe, while hard peaches from the same position required from 2 to 3 days, so

T A B L E 3

APPROXIMATE TIME REQUIRED FOR EXPERIMENTAL LOTS OF PEACHES TO
BE HELD IN NEW YORK AT ROOM TEMPERATURE (74° to 84° F.) BEFORE REACHING
BEST CONDITION FOR RETAILER 1/

| Test No. | Variety | Date Loaded | Fruit in Refrigerator Car | Location of Basket in Load | | | | | |
|----------|---------|-------------|---------------------------|----------------------------|------|------|-----------|------|------|
| | | | | Bottom Layer | | | Top Layer | | |
| | | | | Firm | Hard | Firm | Hard | | |
| | | | days | days | days | days | days | days | days |
| 1 | Hiley | 6-14 | 2.5 | 0.5 | 0 2/ | 0 2/ | 0 2/ | 0 3/ | 0 2/ |
| 2 | Do | 6-15 | 2.5 | 1 | 1 | 2 | 0 3/ | 0 3/ | 1 |
| 3 | do | 6-17 | 2.5 | 1 | 1 | 2 | 0 3/ | 0 3/ | 1 |
| 4 | Belle 4 | 6-27 | 2.7 | 1-2 | 1-2 | 2 | 1 | 1 | 2 |
| 5 | Elberta | 6-28 | 4-7 5/ | 1 | 1 | 1-2 | 0 3/ | 0 3/ | 1 |
| 6 | do | 6-29 | 2.5 | 0-1 | 0-1 | 1 | 0-1 | 0-1 | 1 |
| 7 | do | 7-1 | 5.3 | 0-1 | 0-1 | 1 | 0 3/ | 0 3/ | 1 |

1/ Assuming that the retailer desires firm-ripe to firm peaches with very few ripe.

2/ Not suitable for retailer at time of unloading.

3/ Slightly soft for best retailing at time of unloading.

4/ Car in test 4 precooled; all others not precooled.

5/ Top layer test baskets in car 4 days; bottom layer 7 days.

T A B L E 4

APPROXIMATE TIME REQUIRED FOR EXPERIMENTAL LOTS OF PEACHES TO BE HELD IN NEW YORK AT ROOM TEMPERATURES (74 to 84 F.) BEFORE BECOMING GENERALLY RIPE OR IN BEST CONDITION FOR CONSUMER. 1/

| Test No. | Variety | Date Loaded | Fruit in Refrigerator Cars | Location of Baskets in Load | | | | | | | |
|----------|----------|-------------|----------------------------|-----------------------------|-----------|-----------|-----|-----------|-----------|-----------|-----|
| | | | | Bottom Layer | | | | Top Layer | | | |
| | | | | Firm | | Hard | | Firm | | Hard | |
| | | | | Vent Pad. | Std. Pad. | Vent. Pad | Pad | Vent. Pad | Std. Pad. | Vent. Pad | Pad |
| 1 | Hiley | 6-14 | 2.5 | 2 | 2 | 2 | | 1 | 1 | | 2 |
| 2 | Do | 6-15 | 2.5 | 2 | 2 | 4 | | 1 | 1 | | 3 |
| 3 | do | 6-17 | 2.5 | 2-3 | 2 | 4 | | 1-2 | 1-2 | | 2-3 |
| 4 | Belle 3/ | 6-27 | 2.7 | 3 | 3 | 4 | | 3 | 2-3 | | 4 |
| 5 | Elberta | 6-28 | 4-7 2/ | 2 | 2 | 3 | | 2 | 2 | | 2-3 |
| 6 | do | 6-29 | 2.5 | 2 | 2 | 3 | | 2 | 2 | | 3 |
| 7 | do | 7-1 | 5.3 | 1-2 | 1 | 2 | | 1 | 1 | | 2 |

1/ Practically all fruit was still suitable for consumption 1 to 2 days longer than shown in table.

2/ Top layer test baskets in car 4 days; bottom layer, 7 days.

3/ Car in test 4 precooled; all others not precooled.

that there was an advantage of 1 day more for the precooled shipment. Fruit shipped in the bottom layer could be held longer before becoming generally ripe than could comparable peaches shipped in the top layer. In some cases they could be held about twice as long.

Influence of Ventilated Pad

Some difference was noted at destination in the maturity of comparable fruit shipped in baskets with the ventilated pad as compared with that having the standard pad. Generally fruit packed with the ventilated pad reached the stage "suitable for retailer" within a day after that shipped with the standard pad.

More striking differences were noted in a small express shipment from Ft. Valley to the Washington laboratory. Two baskets of yellow Hiley peaches were shipped from the experimental orchards at Ft. Valley to Washington, D. C. The baskets were comparable, except that one was packed with the ventilated pad and the other with the standard pad. The peaches were picked the morning of June 17, shipped that evening, and were inspected on the morning of June 20. The results of the inspection are tabulated in table 5.

T A B L E 5

INSPECTION DATA ON TWO BASKETS OF PEACHES SHIPPED BY EXPRESS
FROM FT. VALLEY TO WASHINGTON, D. C.

| Item | Ventilated Pad | | Standard Pad | |
|------------------------|----------------|---------|--------------|---------|
| | Number | Percent | Number | Percent |
| Total fruits..... | 106 1/ | 100.0 | 113 | 100 |
| Decay: | | | | |
| Rhizopus..... | 3 | 2.8 | 13 | 11.5 |
| Brown Rot..... | 21 | 19.8 | 40 | 35.4 |
| Badly bruised..... | 15 | 14.0 | 14 | 12.4 |
| Ripe and sound..... | 40 | 37.7 | 33 | 29.2 |
| Mature (not ripe)..... | 27 | 25.7 | 13 | 11.5 |

1/ Part of "facers" removed from package before delivery.

There was a marked difference between the amount of decay found in the two baskets. Since both of the decay organisms developed best at high temperatures it is apparent that conditions were best for their growth in the basket with the standard pad. That lower temperatures were secured with the ventilated pad also appeared from the fact that the rate of ripening was slowed down, since there were twice as many mature fruits in this basket as in the one having the ordinary pad.

Flavor and Quality

The flavor and quality of hard peaches varied considerably in the different test cars.

Test No. 1. The hard fruit had almost as good flavor as the firm fruit, and the difference was of no commercial importance. This car was shipped at about the peak of the Hiley season following a week-end when no fruit was picked, so that the fruit was much riper than that generally shipped. No doubt the hard fruit in this car was more mature than that in the subsequent shipments.

Test No. 2. The hard fruit was definitely inferior to the firm fruit after being ripened. The former was angular, not plump or filled out, the flesh was acid and definitely lacking in the flavor associated with the Hiley variety and would be classified as fair to poor.

Test No. 3. The difference in flavor between the hard and the firm fruit was not as noticeable as in Test 2 but more in line with that in Test 1. The flavor of the hard fruit was acid, but this would not have been as noticeable if riper fruit had not been present for comparison.

Test No. 4. The hard fruit was the poorest of any of the test fruit when ripened. The flavor was acid and lacking in aroma to such an extent that a consumer would have had no desire for more. The firm fruit ripened with good quality.

Tests Nos. 5,6, and 7. The hard fruit in these three cars was inferior to the firm fruit because of lack of sweetness, aromatic flavor, and general appearance. While this hard fruit ripened with good to fair quality and although the average consumer would have found it acceptable, doubtless he would have enjoyed the firm fruit more.

Color and appearance

The one consistent difference between the hard and the firm fruit was the lack of color and attractive appearance in the former. This was due to the green ground color, lack of blush, and in Tests 2 and 4 to the fact that the hard fruit was somewhat angular and not filled out. The firm fruit when ripened had a deep yellow to orange color and generally showed much more blush than the less mature fruit.

Bruising and Decay.

Bruising was more severe in the firm fruit than in the hard, ranging from 4 to 8 percent in the former and from 0 to 2 or 3 percent in the latter. In most cases it was not of commercial significance.

On arrival at destination the amount of decay was negligible, and even after ripening it was small. An occasional basket showed from 1 to 3 percent decay, mostly brown rot, with a small percentage of Rhizopus rot.

Discussion

The peach at its best has a delicious flavor and an attractive appearance. These characteristics develop to the highest degree when the fruit is permitted

to mature on the tree. Tree-ripened peaches cannot be shipped to distant markets and as a rule can only be utilized for consumption near point of production. However, peaches can be picked at a stage of maturity which will permit them to be shipped to distant markets and still ripen with good quality. To do this it is necessary to slow down the ripening processes because otherwise the peaches soften quickly and become unsalable within a few days. Ripening can be retarded best by precooling the fruit within a few hours after picking and by keeping it at a sufficiently low temperature thereafter.

Several conditions have recently arisen which should permit the shipment of riper peaches than are now commonly shipped from the early peach-producing sections. These are: (1) faster freight schedules, which have materially reduced the time in transit, (2) increased precooling facilities, and (3) an improved package which permits more rapid cooling of the fruit.

The results of this season's work show that firm peaches having a greyish-white to creamy-white, or yellowish ground color will remain in a marketable condition for 3 to 4 days after unloading, even when held at fairly high temperatures, provided they are cooled quickly, or are transported in the bottom layer of the load. Nonprecooled firm fruit carried in the top layer arrived in a riper condition and could not be held more than 1 to 2 days. Firm fruit ripened with good quality and had an attractive color, which was quite in contrast to most of the hard fruit which did not ripen with good quality or attractive color.

Hard peaches with a green ground color and shipped under the same conditions softened about one day later than those that were firm when shipped. Upon ripening they had an acid flavor and were generally inferior

in quality and flavor to the riper fruit. In two shipments the hard peaches were hardly edible after ripening.

The use of the ventilated pad with nonprecooled shipments did not lengthen the marketing period as much as a day, so it appears that its main value is with precooled shipments. As previously shown, by use of ventilated pads and baskets the length of time required to thoroughly precool them is lessened considerably and insures a more rapid drop in temperature of the fruit at the center of the basket. When the standard pad is used the cooling is largely confined to the peaches next the sides of the basket, those in the center cooling very slowly by conduction. Greater differences might have resulted if the test lots with the ventilated pad had come from an entire carload packed in this way. As it was the temperatures in packages with ventilated pads were doubtless influenced to a great extent by the temperature of the surrounding fruit in standard packages, which previous work has shown do not cool as rapidly.

Precooling is a valuable means of reducing losses from brown rot and other decays. It should be of greatest value however for shipments of riper peaches than are now being marketed. For the hard, green peaches which are customarily shipped, it would be better not to precool them unless there is reason to anticipate trouble from decay in transit. In the absence of precooling, such peaches will ripen somewhat in transit and be in a more edible condition on arrival at market, and the cost of precooling can be saved.